

Building a Stairway to **Centralised WSN Control**



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Motivation

- Flow scheduling with different QoS requirements
- Facilitate network-wide management and control

Centralised Network Control

Current Solutions

- Limited scalability [WirelessHART]
- Incomplete network topology models [Hydro]

SMOG

Contribution

- A mechanism to build and maintain a centralised full network topology model:
- accurate, reactive, and scalable
- usage of probabilistic data structures
- Extensive analysis in simulations and a testbed

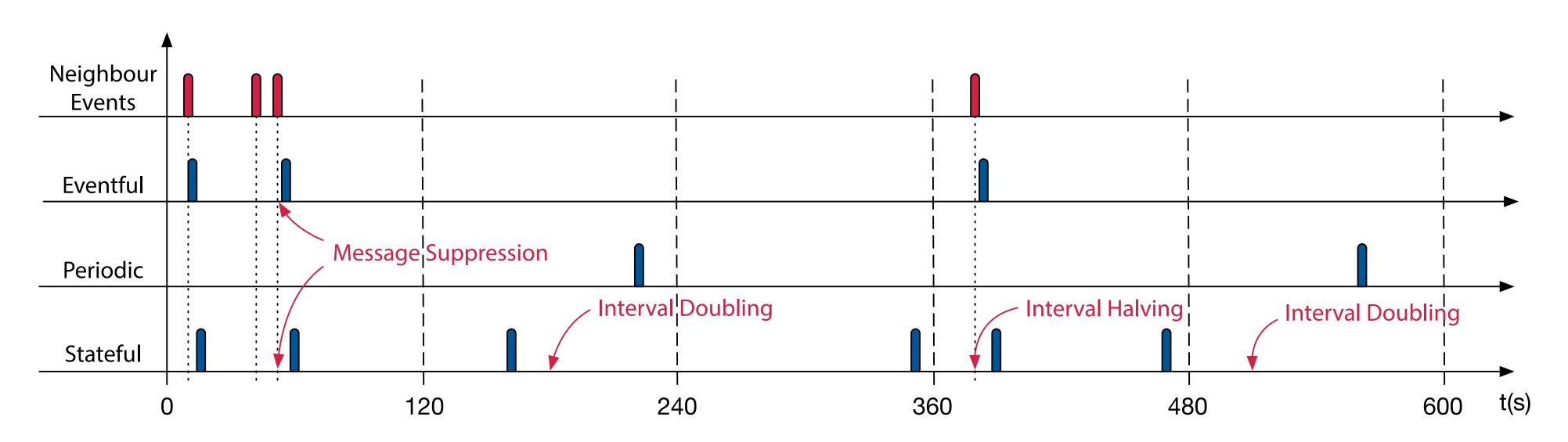
SMOG Design

How It Works Network Model RPL Root & Network Controller #2 BF 0 1 1 0 1 0 1 #2 BF 0 1 1 0 1 0 1 ‡2 BF 0 1 1 0 1 0 1 #2 BF 0 1 0 0 1 0 0 #4 BF 0 1 0 1 0 0 0 #4 BF 0 1 0 1 0 0 0 #4 BF 0 1 0 1 0 0 0 6LoWPAN + RPL Network #2 adds #4 to Nbr Cache and BF #2 sends SMOG message to #1 #1 receives SMOG message from #2 **Initial State** #1 discovers link from #2 to #4 #2 schedules a SMOG message to be sent according to a MOP #1 updates the Network Model

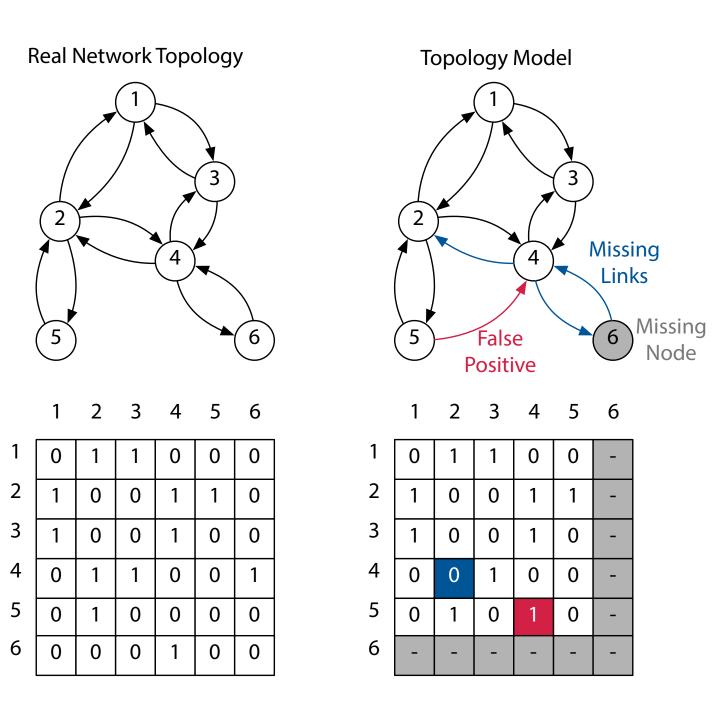
Features

- Complete network model as a directed graph
- Depends on: RPL & IPv6 NDP
- Probabilistic: Bloom Filters (BFs) are used to compress neighbourhood information
- Modes of Operation: Eventful, Periodic, & Stateful
- False Positive Discovery Mechanisms
- Model Accuracy (Ma) = f(Inconsistencies)

Modes of Operation (MOPs)

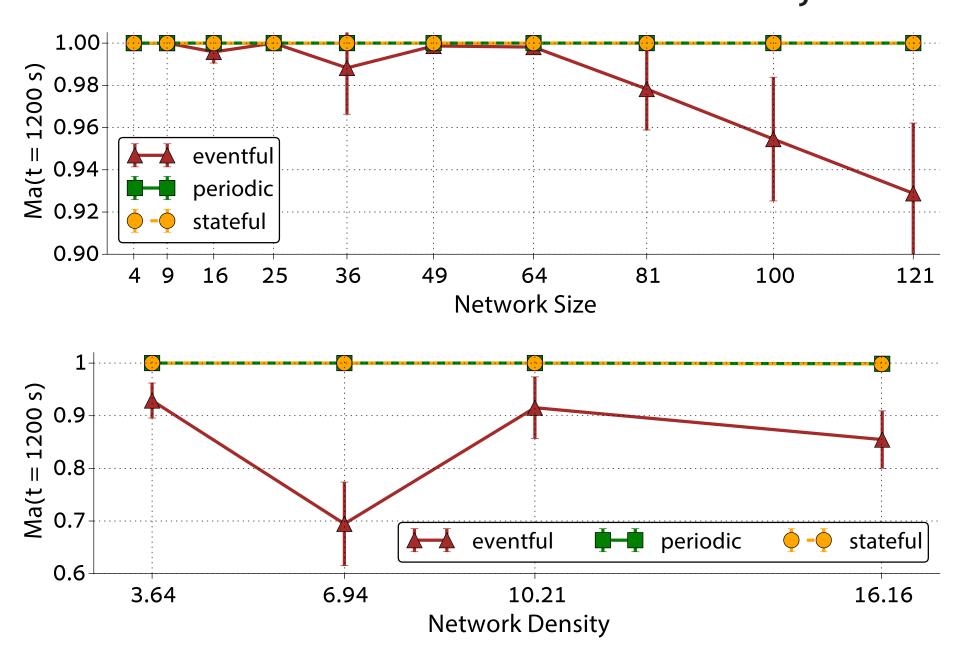


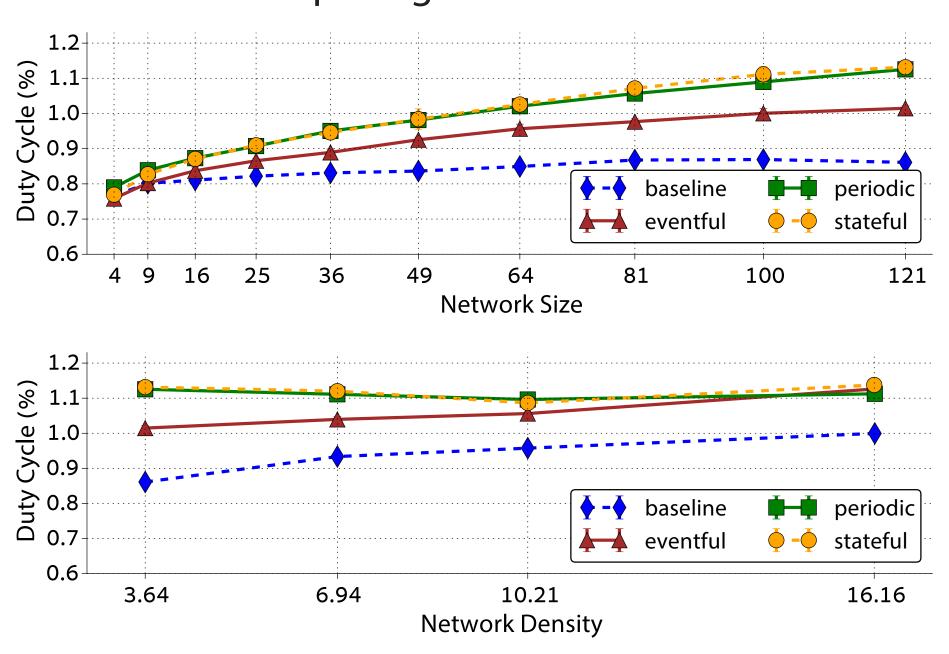
Inconsistencies

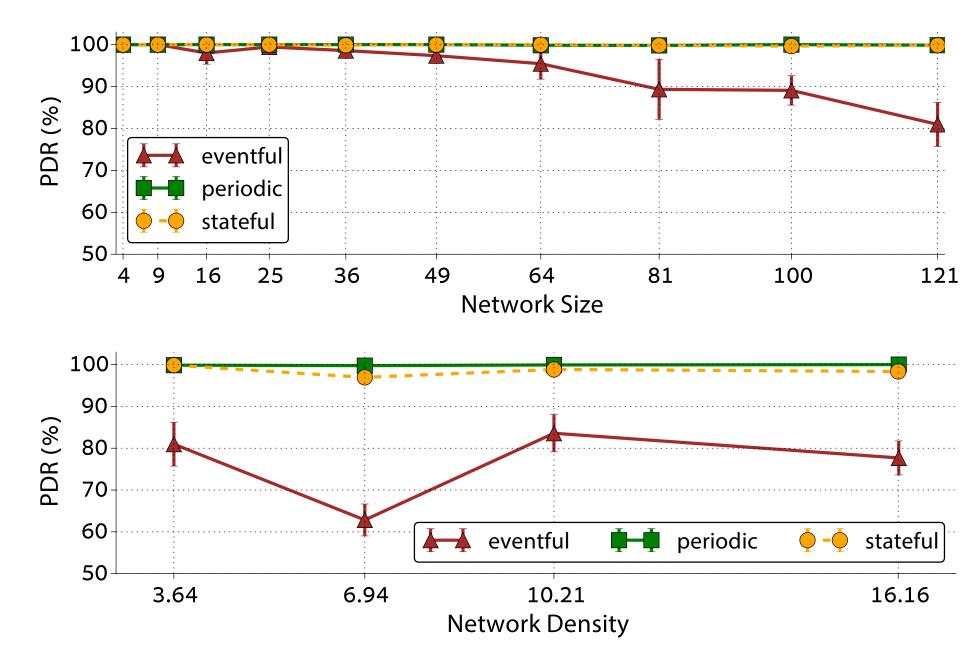


Evaluation

Simulation-based Evaluation: Cooja simulations with different square grid networks with a corner sink and UDGM radio model.







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TX Power (dBm)

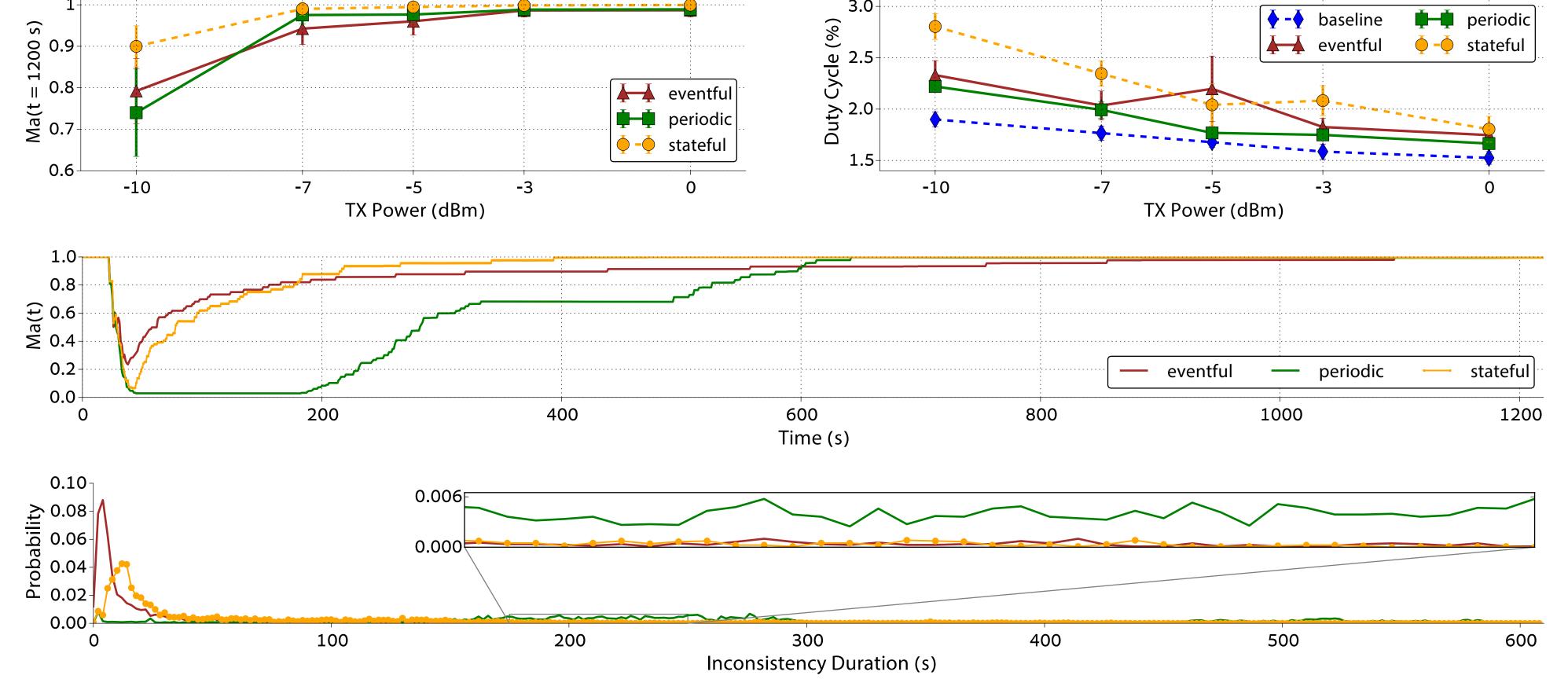
SMOG scales, at least, up to 121 nodes

Trade-off between reactivity and overhead

High accuracy with low overhead

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Testbed-based Evaluation: Experiments in Indriya Testbed (100 nodes) with five different transmission powers resulting in networks with different densities.



SMOG under churn

Link classification

→ eventful

periodic

stateful

Future Work

Conclusions

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Network control

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